

DEPARTMENT OF THE NAVY (DON)
21.2 Small Business Innovation Research (SBIR)
Direct to Phase II (DP2) Announcement and Proposal Submission Instructions

IMPORTANT

- **The following instructions apply to Direct to Phase II (DP2) SBIR topics only:**
 - N212-D03 to N212-D05
- **The information provided in the DON Proposal Submission Instruction document takes precedence over the DoD Instructions posted for this Broad Agency Announcement (BAA).**
- **Proposers that are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF) or any combination of these are eligible to submit proposals in response to DON topics advertised in this BAA. Information on Majority Ownership in Part and certification requirements at time of submission for these proposers are detailed in the section titled ADDITIONAL NOTES.**
- A DP2 Phase I Feasibility proposal template, unique to DP2 topics, is available at https://www.navysbir.com/links_forms.htm; use this template to meet Volume 2 requirements.
- DON provides notice that Basic Ordering Agreements (BOAs) or Other Transaction Agreements (OTAs) may be used for Phase II awards.
- The Supporting Documents Volume (Volume 5) is available for the SBIR 21.2 BAA cycle. The Supporting Documents Volume is provided for small businesses to submit additional documentation to support the Technical Volume (Volume 2) and the Cost Volume (Volume 3). Volume 5 is available for use when submitting Phase I and Phase II proposals. DON will not be using any of the information in Volume 5 during the evaluation.

INTRODUCTION

The Director of the DON SBIR/STTR Programs is Mr. Robert Smith. For questions regarding this BAA, use the information in Table 1 to determine who to contact for what types of questions.

TABLE 1: POINTS OF CONTACT FOR QUESTIONS REGARDING THIS BAA

Type of Question	When	Contact Information
Program and administrative	Always	Program Managers list in Table 2 (below)
Topic-specific technical questions	BAA Pre-release	Technical Point of Contact (TPOC) listed in each topic. Refer to section 4.13 of the DoD BAA for details.
	BAA Open	DoD SBIR/STTR Topic Q&A platform (https://www.dodsbirsttr.mil/submissions) Refer to section 4.13 of the DoD BAA for details.

Electronic submission to the DoD SBIR/STTR Innovation Portal (DSIP)	Always	DoD Help Desk via email at dodsbirsupport@reisystems.com
Navy-specific BAA instructions and forms	Always	Navy-sbir-sttr.fct@navy.mil

TABLE 2: DON SYSTEMS COMMAND (SYSCOM) SBIR PROGRAM MANAGERS

<u>Topic Numbers</u>	<u>Point of Contact</u>	<u>SYSCOM</u>	<u>Email</u>
N212-D03 to N212-D05	Ms. Donna Attick	Naval Air Systems Command (NAVAIR)	navair.sbir@navy.mil

The DON SBIR/STTR Programs are mission-oriented programs that integrate the needs and requirements of the DON’s Fleet through research and development (R&D) topics that have dual-use potential, but primarily address the needs of the DON. More information on the programs can be found on the DON SBIR/STTR website at www.navysbir.com. Additional information pertaining to the DON’s mission can be obtained from the DON website at www.navy.mil.

During government fiscal years (FY) 2012 through 2022, the Department of Defense (DoD), including the Department of the Navy (DON), may issue an SBIR award to a small business firm under Phase II, without regard to whether the firm received a Phase I award for such project. Prior to such an award, the head of the agency, or their designee, must issue a written determination that the firm has demonstrated the scientific and technical merit and feasibility of the technology solution that appears to have commercial potential (for use by the government or in the public sector). The determination must be submitted to the Small Business Administration (SBA) prior to issuing the Phase II award. As such, DON issues this portion of the BAA in accordance with the requirements of the Direct to Phase II (DP2) authority. Only those firms that are capable of meeting the DP2 proposal requirements may participate in this DP2 BAA. No Phase I awards will be issued to the designated DP2 topic.

Each eligible topic requires documentation to determine that Phase I feasibility, described in the Phase I section of the topic, has been met.

The DON SBIR DP2 is a two-step process:

STEP ONE: Prepare and Submit a Phase I Feasibility Proposal (instructions and link to template provided below). The purpose of the Phase I Feasibility Proposal is for the firm to provide documentation to substantiate that both Phase I feasibility and the scientific and technical merit described in the topic have been met. The Phase I Feasibility Proposal must: demonstrate that the firm performed Phase I-type research and development (R&D) and provide a concise summary of Phase II objectives, work plan, related research, key personnel, transition/commercialization plan, and estimated costs. Feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work. The government will evaluate Phase I Feasibility Proposals and select firms to submit a Full DP2 Proposal. Demonstrating proof of feasibility is a requirement for a DP2 award. The firm must submit a Phase I Feasibility Proposal to be considered for selection to submit a Full DP2 Proposal.

STEP TWO: If selected, the cognizant SYSCOM Program Office will contact the firm directly to provide instructions on how to submit a Full DP2 Proposal.

DON SBIR reserves the right to make no awards under this DP2 BAA. All awards are subject to availability of funds and successful negotiations. Proposers must read the topic requirements carefully. The Government is not responsible for expenditures by the proposer prior to award of a contract. For 21.2 topics designated as DP2, DON will accept only Phase I Feasibility Proposals (described below).

Proposers are required to submit proposals via the Defense SBIR/STTR Innovation Portal (DSIP) <https://www.dodsbirsttr.mil/submissions>; proposals submitted by any other means will be disregarded. Proposers submitting through this site for the first time will be asked to register. It is recommended that firms register as soon as possible upon identification of a proposal opportunity to avoid delays in the proposal submission process. Proposals that are not successfully certified in DSIP prior to BAA Close will NOT be considered submitted. Please refer to section 5.1 of the DoD SBIR/STTR Program BAA for further information.

DP2 PROPOSAL SUBMISSION REQUIREMENTS

The following **MUST BE MET** or the proposal will be deemed noncompliant and shall be **REJECTED**.

- **Eligibility.** Each proposing firm must:
 - Have demonstrated feasibility of Phase I-type R&D work
 - Have submitted a Phase I Feasibility Proposal for evaluation
 - Meet Offeror Eligibility and Performance Requirements as defined in section 4.2 of the DoD SBIR/STTR Program BAA
 - Comply with primary employment requirements of the principal investigator (PI) during the Phase II award including, employment with the firm at the time of award and during the conduct of the proposed project. Primary employment means that more than one-half of the PI's time is spent in the employ of the firm
 - Register in the System for Award Management (SAM) as defined in section 4.14 of the DoD SBIR/STTR Program BAA. To register, visit <https://beta.sam.gov>

- **Proposal Cover Sheet (Volume 1).** As specified in DoD SBIR/STTR BAA section 5.4(a).

- **Technical Volume (Volume 2).** Technical Volume (Volume 2) must meet the following requirements:
 - Content is responsive to evaluation criteria as specified in DoD SBIR/STTR Program BAA section 6.0
 - Not to exceed **30** pages, regardless of page content
 - Single column format, single-spaced typed lines
 - Standard 8 ½" x 11" paper
 - Page margins one-inch on all sides. A header and footer may be included in the one-inch margin.
 - No font size smaller than 10-point*

*For headers, footers, and imbedded tables, figures, images, or graphics that include text, a font size smaller than 10-point is allowable; however, proposers are cautioned that if the text is too small to be legible it will not be evaluated.

Volume 2 is the technical proposal. Additional documents may be submitted to support Volume 2 in accordance with the instructions for Supporting Documents Volume (Volume 5) as detailed below.

The Technical Volume (Volume 2) should include the following sections:

- Phase I Proof of Feasibility (NTE 20 pages)
 1. Introductory Statement
 2. Phase I Proof of Feasibility
 3. Commercialization Potential/Transition Plan Summary

- Snapshot of Proposed Phase II Effort (NTE 10 pages)
 1. Description of Proposed DP2 Technical Effort and Objectives
 2. DP2 Work Plan
 3. Key Personnel Resumes – should be submitted for the Principal Investigator and up to 4 additional individuals. Resumes are limited to one page per person, and should be limited to only information relevant to the work to be performed under the project
 4. Subcontractors/Consultants
 5. Facilities/Equipment - Describe available instrumentation and physical facilities necessary to carry out the effort.
 6. Order of Magnitude Cost Estimate Table (example provided below in the Cost Volume (Volume 3) section).

It is recommended that proposers use the DP2 Phase I Feasibility proposal template at https://www.navysbir.com/links_forms.htm.

Disclosure of Information (DFARS 252.204-7000)

In order to eliminate the requirements for prior approval of public disclosure of information (in accordance with DFARS 252.204-7000) under this or any subsequent award, the proposer shall identify and describe all fundamental research to be performed under its proposal, including subcontracted work, with sufficient specificity to demonstrate that the work qualifies as fundamental research. Fundamental research means basic and applied research in science and engineering, the results of which ordinarily are published and shared broadly within the scientific community, as distinguished from proprietary research and from industrial development, design, production, and product utilization, the results of which ordinarily are restricted for proprietary or national security reasons. Simply identifying fundamental research in the proposal does NOT constitute acceptance of the exclusion. All exclusions will be reviewed and noted in the award. NOTE: Fundamental research included in the technical proposal that the proposer is requesting be eliminated from the requirements for prior approval of public disclosure of information, must be uploaded in a separate document (under “Other”) in the Supporting Documents Volume (Volume 5).

- **Cost Volume (Volume 3).** The text fields related to costs for the proposed effort must be answered in the Cost Volume of the DoD Submission system (at <https://www.dodsbirsttr.mil/submissions/>), however, proposers DO NOT need to download and complete the separate cost volume template for the DON SBIR Phase I Feasibility Proposal. Proposers are to include a cost estimate in the Order of Magnitude Cost Estimate Table (example below) within the Technical Volume (Volume 2). Please refer to Table 3 below for guidance on cost and period of performance. Costs for the Base and Option are to be separate and identified on the Proposal Cover Sheet and in the Order of Magnitude Cost Estimate Table in the Technical Volume (Volume 2).

Order of Magnitude Cost Estimate Table			
Line Item – Details	Estimated Base Amount	Estimated Option Amount	Total Estimated Amount Base + Option
Direct Labor (fully burdened) – Prime			
Subcontractors/Consultants			
Material			
Travel & ODC			
G&A			
FCCM			
Fee/Profit			
TABA (NTE \$25K, included in total amount)			
Total Estimated Costs			

TABLE 3: COST & PERIOD OF PERFORMANCE

Topic Number	Base		Option One		Total (NTE)
	Cost (NTE)	POP (NTE)	Cost (NTE)	POP (NTE)	
N212-D03 to N212-D05	\$800,000	24 mos.	\$300,000	12 mos.	\$1,100,000

- **Company Commercialization Report (Volume 4).** DoD requires Volume 4 for submission to the 21.2 DP2 BAA. Please refer to instructions provided in section 5.4.e of the DoD SBIR/STTR Program BAA.
- **Supporting Documents (Volume 5).** Volume 5 is available for use when submitting Phase I and Phase II proposals.

The DoD must comply with Section 889(a)(1)(B) of the FY2019 National Defense Authorization Act (NDAA) and is working to reduce or eliminate contracts, or extending or renewing a contract with an entity that uses any equipment, system, or service that uses covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. **As such, all proposals must include as a part of their submission a written certification in response to the NDAA clauses (Federal Acquisition Regulation clauses 52.204-24, 52-204-25 and 52-204-26).** The written certification can be found in Attachment 1 of the DoD SBIR/STTR Program BAA. This certification must be signed by the authorized company representative and is to be uploaded as a separate PDF file in Volume 5. Failure to submit the required certification as a part of the proposal submission process will be cause for rejection of the proposal submission without evaluation. Please refer to instructions provided in section 5.4.g of the DoD SBIR/STTR Program BAA.

In accordance with DFARS provision 252.209-7002, a proposer is required to disclose any interest a foreign government has in the proposer when that interest constitutes control by foreign government. Proposers must review the Foreign Ownership or Control Disclosure information to determine applicability. If applicable, an authorized firm representative must complete the

Disclosure of Offeror's Ownership or Control by a Foreign Government (found in Attachment 2 of the DoD SBIR/STTR Program BAA) and upload as a separate PDF file in Volume 5. Please refer to instructions provided in section 5.4.h of the DoD SBIR/STTR Program BAA.

Volume 5 is available for small businesses to submit additional documentation to support the Technical Proposal (Volume 2) and the Cost Volume (Volume 3). A template is available on https://navysbir.com/links_forms.htm. DON will not be using any of the information in Volume 5 during the evaluation.

- Additional Cost Information
- SBIR/STTR Funding Agreement Certification
- Data Rights
- Allocation of Rights between Prime and Subcontractor
- Disclosure of Information (DFARS 252.204-7000)
- Prior, Current, or Pending Support of Similar Proposals or Awards
- Foreign Citizens
- Majority-Owned VCOC, HF, and PEF Certification, if applicable

NOTE: The inclusion of documents or information other than that listed above (e.g., resumes, test data, technical reports, publications) may result in the proposal being deemed "Non-compliant" and REJECTED.

A font size smaller than 10-point is allowable for documents in Volume 5; however, proposers are cautioned that the text may be unreadable.

- **Fraud, Waste and Abuse Training Certification (Volume 6).** DoD requires Volume 6 for submission to the 21.2 DP2 BAA. Please refer to instructions provided in section 5.4.i of the DoD SBIR/STTR Program BAA.

DON SBIR PHASE I FEASIBILITY PROPOSAL SUBMISSION CHECKLIST

- **Subcontractor, Material, and Travel Cost Detail.** In the Cost Volume (Volume 3), proposers must provide sufficient detail for subcontractor, material and travel costs. Subcontractor costs must be detailed to the same level as the prime contractor. Material costs must include a listing of items and cost per item. Travel costs must include the purpose of the trip, number of trips, location, length of trip, and number of personnel. The "Additional Cost Information" of Volume 5 may be used if additional space is needed to detail these costs. When a proposal is selected for award, be prepared to submit further documentation to the SYSCOM Contracting Officer to substantiate costs (e.g., an explanation of cost estimates for equipment, materials, and consultants or subcontractors).
- **Performance Benchmarks.** Proposers must meet the two benchmark requirements for progress toward Commercialization as determined by the Small Business Administration (SBA) on June 1 each year. Please note that the DON applies performance benchmarks at time of proposal submission, not at time of contract award.
- **Discretionary Technical and Business Assistance (TABAs).** If TABA is proposed, the information required to support TABA (as specified in the TABA section below) must be included in Volume 5 as "Additional Cost Information". Failure to include the required information in Volume 5 will result in the denial of TABA. TABA may be proposed for a DP2 effort which will be included as part of the award amount and limited by the established award values for Phase II by the SYSCOM. The total value of TABA must not exceed \$25,000 under this DP2 contract.

DISCRETIONARY TECHNICAL AND BUSINESS ASSISTANCE (TABA)

The SBIR and STTR Policy Directive section 9(b) allows the DON to provide TABA (formerly referred to as DTA) to its awardees. The purpose of TABA is to assist awardees in making better technical decisions on SBIR/STTR projects; solving technical problems that arise during SBIR/STTR projects; minimizing technical risks associated with SBIR/STTR projects; and commercializing the SBIR/STTR product or process, including intellectual property protections. Firms may request to contract these services themselves through one or more TABA providers in an amount not to exceed the values specified below. The Phase II TABA amount is up to \$25,000 per award. The TABA amount, of up to \$25,000, is to be included as part of the award amount and is limited by the established award values for Phase II by the SYSCOM (i.e. within the \$1,700,000 or lower limit specified by the SYSCOM). The amount proposed for TABA cannot include any profit/fee application by the SBIR/STTR awardee and must be inclusive of all applicable indirect costs. A Phase II project may receive up to an additional \$25,000 for TABA as part of one additional (sequential) Phase II award under the project for a total TABA award of up to \$50,000 per project. A TABA Report, detailing the results and benefits of the service received, will be required annually by October 30.

Approval of direct funding for TABA will be evaluated by the DON SBIR/STTR Program Office. If the TABA request does not include the following items the TABA request will be denied.

- TABA provider(s) (firm name)
- TABA provider(s) point of contact, email address, and phone number
- An explanation of why the TABA provider(s) is uniquely qualified to provide the service
- Tasks the TABA provider(s) will perform
- Total TABA provider(s) cost, number of hours, and labor rates (average/blended rate is acceptable)

TABA must NOT:

- Be subject to any profit or fee by the SBIR applicant
- Propose a TABA provider that is the SBIR applicant
- Propose a TABA provider that is an affiliate of the SBIR applicant
- Propose a TABA provider that is an investor of the SBIR applicant
- Propose a TABA provider that is a subcontractor or consultant of the requesting firm otherwise required as part of the paid portion of the research effort (e.g., research partner, consultant, tester, or administrative service provider)

TABA requests must be included as follows:

- DP2:
 - Order of Magnitude Cost Estimate Table (within the Technical Proposal, Volume 2) – the value of the TABA request.
 - Online DoD Cost Volume (Volume 3) – the value of the TABA request.
 - Supporting Document Volume (Volume 5) – a detailed request for TABA (as specified above) specifically identified as “Discretionary Technical and Business Assistance”.

Proposed values for TABA must NOT exceed:

- A total of \$25,000 per award, not to exceed \$50,000 per Phase II project

If a proposer requests and is awarded TABA in a Phase II contract, the proposer will be eliminated from participating in the DON SBIR/STTR Transition Program (STP), the DON Forum for SBIR/STTR Transition (FST), and any other assistance the DON provides directly to awardees.

All Phase II awardees not receiving funds for TABA in their awards must attend a one-day DON STP meeting during the first or second year of the Phase II contract. This meeting is typically held in the

spring/summer in the Washington, D.C. area. STP information can be obtained at: <https://navystp.com>. Phase II awardees will be contacted separately regarding this program. It is recommended that Phase II cost estimates include travel to Washington, D.C. for this event.

EVALUATION AND SELECTION

The DON will evaluate and select Phase I Feasibility proposals and DP2 proposals using the evaluation criteria in Sections 6.0 and 7.0 of the DoD SBIR/STTR Program BAA respectively, with technical merit being most important, followed by qualifications of key personnel and commercialization potential of equal importance. Due to limited funding, the DON reserves the right to limit awards under any topic.

Approximately one week after the DP2 BAA closing, e-mail notifications that proposals have been received and processed for evaluation will be sent. Consequently, the e-mail address on the proposal Cover Sheet must be correct.

Selected Phase I Feasibility proposers will be notified to submit Full DP2 Proposals. SYSCOM-specific Full DP2 Proposal guidance will be provided at the time of this notification.

Requests for a debrief must be made within 15 calendar days of select/non-select notification via email as specified in the select/non-select notification. Please note debriefs are typically provided in writing via email to the Corporate Official identified in the firm proposal within 60 days of receipt of the request. Requests for oral debriefs may not be accommodated. If contact information for the Corporate Official has changed since proposal submission, a notice of the change on company letterhead signed by the Corporate Official must accompany the debrief request.

Protests of the Phase I Feasibility evaluations and DP2 selections and awards must be directed to the cognizant Contracting Officer for the DON Topic Number, or filed directly with the Government Accountability Office (GAO). Contact information for Contracting Officers may be obtained from the DON SYSCOM Program Managers listed in Table 2. If the protest is to be filed with the GAO, please refer to instructions provided in section 4.11 of the DoD SBIR/STTR Program BAA.

Protests to this BAA and proposal submission must be directed to the DoD SBIR/STTR Program BAA Contracting Officer, or filed with the GAO. Contact information for the DoD SBIR/STTR Program BAA Contracting Officer can be found in section 4.11 of the DoD SBIR/STTR Program BAA.

CONTRACT DELIVERABLES

Contract deliverables are typically progress reports and final reports. Required contract deliverables must be uploaded to <https://www.navysbirprogram.com/navydeliverables/>.

AWARD AND FUNDING LIMITATIONS

Awards. The DON typically awards a Cost Plus Fixed Fee contract for DP2; but, may consider other types of agreement vehicles, such as an Other Transaction Agreement (OTA) or a Basic Ordering Agreement (BOA) as specified in 10 U.S.C. 2371/10 U.S.C. 2371b and related implementing policies and regulations. The DON may choose to use a Basic Ordering Agreement (BOA) for Phase II awards. DP2 awards can be structured in a way that allows for increased funding levels based on the project's transition potential. To accelerate the transition of SBIR/STTR-funded technologies to Phase III, especially those that lead to Programs of Record and fielded systems, the Commercialization Readiness Program was authorized and created as part of section 5122 of the National Defense Authorization Act of Fiscal Year 2012. The statute set-aside is 1% of the available SBIR/STTR funding to be used for administrative support to accelerate transition of SBIR/STTR-developed technologies and provide non-financial resources for the firms (e.g., the DON STP).

TRANSFER BETWEEN SBIR AND STTR PROGRAMS

Section 4(b)(1)(i) of the SBIR and STTR Policy Directive provides that, at the agency's discretion, projects awarded a Phase I under a BAA for SBIR may transition in Phase II to STTR and vice versa. Please refer to instructions provided in section 7.2 of the DoD SBIR/STTR Program BAA.

ADDITIONAL NOTES

Majority Ownership in Part. Proposers which are more than 50% owned by multiple venture capital operating companies (VCOC), hedge funds (HF), private equity firms (PEF), or any combination of these as set forth in 13 C.F.R. § 121.702, are eligible to submit proposals in response to DON topics advertised within this BAA.

For proposers that are a member of this ownership class the following must be satisfied for proposals to be accepted and evaluated:

- a. Prior to submitting a proposal concerns must register with the SBA Company Registry Database.
- b. The proposer within its submission must submit the Majority-Owned VCOC, HF, and PEF Certification. A copy of the SBIR VC Certification can be found on https://navysbir.com/links_forms.htm. Include the SBIR VC Certification in the Supporting Documents Volume (Volume 5).
- c. Should a proposer become a member of this ownership class after submitting its application and prior to any receipt of a funding agreement, the proposer must immediately notify the Contracting Officer, register in the appropriate SBA database, and submit the required certification which can be found on https://navysbir.com/links_forms.htm.

Human Subjects, Animal Testing, and Recombinant DNA. If the use of human, animal, and recombinant DNA is included under a DP2 proposal, please carefully review the requirements at: <http://www.onr.navy.mil/About-ONR/compliance-protections/Research-Protections/Human-Subject-Research.aspx>. This webpage provides guidance and lists approvals that may be required before contract/work can begin.

System for Award Management (SAM). It is strongly encouraged that proposers register in SAM, <https://beta.sam.gov>, by the Close date of this BAA, or verify their registrations are still active and will not expire within 60 days of BAA Close. Additionally, proposers should confirm that they are registered to receive contracts (not just grants) and the address in SAM matches the address on the proposal.

International Traffic in Arms Regulation (ITAR). For topics indicating ITAR restrictions or the potential for classified work, limitations are generally placed on disclosure of information involving topics of a classified nature or those involving export control restrictions, which may curtail or preclude the involvement of universities and certain non-profit institutions beyond the basic research level. Small businesses must structure their proposals to clearly identify the work that will be performed that is of a basic research nature and how it can be segregated from work that falls under the classification and export control restrictions. As a result, information must also be provided on how efforts can be performed in later phases if the university/research institution is the source of critical knowledge, effort, or infrastructure (facilities and equipment).

Support Contract Personnel for Administrative Functions. Proposers are advised that support contract personnel will be used to carry out administrative functions and may have access to proposals, contract award documents, contract deliverables, and reports. All support contract personnel are bound by appropriate non-disclosure agreements.

PHASE III GUIDELINES

A Phase III SBIR/STTR award is any work that derives from, extends, or completes effort(s) performed under prior SBIR/STTR funding agreements, but is funded by sources other than the SBIR/STTR programs. This covers any contract, grant, or agreement issued as a follow-on Phase III award or any contract, grant, or agreement award issued as a result of a competitive process where the awardee was an SBIR/STTR firm that developed the technology as a result of a Phase I or Phase II award. The DON will give Phase III status to any award that falls within the above-mentioned description, which includes assigning SBIR/STTR Data Rights to any noncommercial technical data and/or noncommercial computer software delivered in Phase III that was developed under SBIR/STTR Phase I/II effort(s). Government prime contractors and/or their subcontractors must follow the same guidelines as above and ensure that companies operating on behalf of the DON protect the rights of the SBIR/STTR firm.

NAVY 21.2 SBIR DIRECT TO PHASE II TOPIC INDEX

N212-D03	DIRECT TO PHASE II - Electrical Capacitors for High-Temperature Power Conversion
N212-D04	DIRECT TO PHASE II - High-Speed Digital Fiber Optic Receiver
N212-D05	DIRECT TO PHASE II – Yield Increase for High-Performance Optical Interference Filters

N212-D03 TITLE: DIRECT TO PHASE II - Electrical Capacitors for High-Temperature Power Conversion

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Electronics

OBJECTIVE: Identify and demonstrate that advances in polymeric (or other film materials) dielectrics can be exploited in high temperature (150 °C–200 °C), compact, long life, highly reliable, electrical power capacitors in aircraft.

DESCRIPTION: Electrification of naval aerospace platforms continues. Aircraft designers are being challenged to supply more power to new classes of nonlinear and constant power loads. In response to these new loads, the electrical power generation/distribution system, as well as the electrical loads themselves, are being required to minimize losses, while rejecting heat at high temperatures and maintaining conversion equipment reliability. A well-established design practice indicates component reliability of their insulation systems can be increased by 2 times for every 100 °C the operating temperature is lowered below the design maximum temperature.

While new classes of power semiconductor switching devices based on wide-bandgap materials (i.e., SiC and GaN) are maturing with advertised operating junction temperatures up to 200 °C, the development of high-temperature, reliable capacitors have not followed suit. To achieve reliability, today's power conversion capacitors are operated at temperatures of ~150 °C – thus limiting converter/inverter fluid-in temperatures at/or below 75 °C.

Capacitors with operating temperatures in the range of -40 °C to 150 °C, with a maximum temperature of 200 °C is the program's primary goal. There are additional characteristics which are important for aircraft including: operation at altitude (up to 70,000 ft (21,336 m)), weight and volume comparable to state-of-the-art aerospace capacitors, equivalent series resistance (< 2 MO goal), and low inductance (< 50 nH goal). In addition, the capacitors are needed for both DC link applications as well as for AC filters. Capacitors with operating capabilities in the temperatures stated above will enable converter/inverter fluid-in cooling temperatures of 100°C or higher.

The Navy requires representative high-temperature capacitors for aircraft electrical DC link and filter applications with the following characteristics that are important for aircraft including, but not limited to:

- DC Voltage Rating (Nominal): 600 Vdc (Target), 500 Vdc
- Capacitance: 300 uF ± 5.0% (1 kHz – 40 kHz & @ 150°C)
- Operation Temperature: -55°C (Start-up) -40°C – +150°C
- Maximum Storage Temperature: 175°C
- ESR: < 1 MO (1 kHz – 40 kHz at 150°C)
- ESL: < 1 nH per mm of lead spacing
- Dissipation Factor (DF): <= 1.8% @10 kHz; <= 7.5% @40 kHz, 150°C
- Ripple Current: 30 Arms average; 10 Arms @ 80 kHz
- Peak Current: 180 A
- Voltage Ripple: 15 V
- Dielectric Withstanding Voltage: 900 V DC voltage for 30 seconds, no reliability impact with the maximum leakage current < 0.5 mA
- dv/dt > 20 V/μS @ 600 V and 150°C
- Vibration/Shock: Random Vibe = 40 Grms, 10-2000 Hz; Shock = 15 gs@11 ms
- Altitude (Partial Discharge): > 65,000 ft (19,812 m)
- Insulation Resistance: 10 MO between positive terminal or negative terminal and case

- Dimension (Target): $\leq 8 \text{ in}^3$ (20.32 cm³)
- Weight (Target): $\leq 2.5 \text{ lb}$ (1.134 kg)

This SBIR topic seeks development of typical aircraft capacitors and demonstration of reliability and life for these capacitors in representative aircraft electrical power conversion applications. The primary target is 600-800 Vdc capacitors to be used in conversion equipment that operates in 400 Hz power system architectures and with Variable Speed Constant Frequency (VSCF) generator control units. Specifically, this includes the F/A-18 where a need for 35% more electrical power is expected. Better capacitors will help ensure a 100 KVA system can operate without major changes to the F/A-18 cooling system. A secondary target will be for application in 270 Vdc power system architectures (e.g., F-35). A strong collaboration with an electrical generation system or components supplier is highly recommended for Phase II.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. Have developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

The proposal must state a capacitor physical design, the high-temperature material characteristics that will be used, and calculation showing the capacitance can be met in the size and weight constraints.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic, but from non-SBIR funding sources) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 21.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this topic.

PHASE II: Develop prototype representative high-temperature capacitors for aircraft electrical DC link and filter applications with the characteristics that are important for aircraft as outlined in the Description.

Develop a test apparatus to demonstrate life and reliability for representative electrical and temperature conditions. Accomplish testing to indicate life and reliability. Deliver test apparatus and test reports. Deliver 25 functional capacitors of each type developed beyond those used in life/reliability testing.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype and perform final testing. Transition in a 100 KVA DC Link Generator Converter Units for use on applicable platforms.

All High-Power Electronic Converters use high-power, high-temperature capacitors to keep size, weight, and cooling requirements low. These characteristics are useful in all commercial converter applications including commercial aircraft, commercial computer centers, and commercial trains.

REFERENCES:

1. Von Kampen, T. "Ensure AC film capacitor reliability with thermal analysis." Power Electronics, March 1, 2001. <https://www.powerelectronics.com/content/ensure-ac-film-capacitor-reliability-thermal-analysis#close-olyticsmodal>.

2. Bray, K., Wu, R. L., Fries-Carr, S. NS Weimer, J. “AFRL-PR-WP/TP2007-221: Multilayer aluminum oxynitride capacitors for higher energy density wide temperature applications (Pre-Print).” Material Science, January 2007. <https://apps.dtic.mil/dtic/tr/fulltext/u2/a466667.pdf>.
3. Demcko, R. S. “Evolution of high-temperature capacitors.” Proceedings 38th Electronics Components Conference May 1988, pp. 390-395. <https://doi.org/10.1109/ECC.1988.12622>.
4. Haywood, R. “Downhole tools in the oilfield services industry: Transformation to improve reliability.” 2017 IEEE Applied Power Electronics Conference and Exposition, Tampa, FL, United States, March 26-30, 2017. <https://www.psma.com/sites/default/files/uploads/tech-forums-capacitor/presentations/is186-downhole-tools-oilfield-services-industry-transformation-improve-reliability.pdf>.

KEYWORDS: High Temperature; Aircraft Capacitor; DC-Link; Converter; 100 KVA DC Link Generator Converter Unit

TPOC-1: Charles Singer
Phone 1: (301) 342-0834
Phone 2: (240) 434-9585

TPOC-2: Eric Giewont
Phone: (301) 342-0365

N212-D04 TITLE: DIRECT TO PHASE II - High-Speed Digital Fiber Optic Receiver

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR);Networked C3

TECHNOLOGY AREA(S): Air Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), 22 CFR Parts 120-130, which controls the export and import of defense-related material and services, including export of sensitive technical data, or the Export Administration Regulation (EAR), 15 CFR Parts 730-774, which controls dual use items. Offerors must disclose any proposed use of foreign nationals (FNs), their country(ies) of origin, the type of visa or work permit possessed, and the statement of work (SOW) tasks intended for accomplishment by the FN(s) in accordance with section 3.5 of the Announcement. Offerors are advised foreign nationals proposed to perform on this topic may be restricted due to the technical data under US Export Control Laws.

OBJECTIVE: Develop and package an uncooled digital fiber optic receiver that operates up to 100 Gbps, binary, non-return-to-zero for air platform fiber optic link applications.

DESCRIPTION: Current airborne military (mil-aero) core avionics, electro-optic (EO), communications and electronic warfare systems require ever-increasing bandwidths while simultaneously demanding reductions in space, weight, and power (SWaP). The replacement of shielded twisted pair wire and coaxial cable with earlier generation, bandwidth-length product, multimode optical fiber has given increased immunity to electromagnetic interference, bandwidth, throughput, and a reduction in size and weight on aircraft. The effectiveness of these systems hinges on optical communication components that realize high per-lane throughput, low latency, large link budget, and are compatible with the harsh avionic environment [Refs 6, 7, 8, 9].

In the future, data transmission rates of 100 Gbps and higher will be required. Substantial work has been done to realize data rates approaching this goal based on the use of multilevel signal coding; but multilevel signal encoding techniques trade off link budget and latency to achieve high digital bandwidth [Refs 1-3]. To be successful in the avionic application, existing non-return-to-zero (NRZ) signal coding with large link budget and low latency must be maintained [Refs 4-5, 10]. Advances in optical receiver designs are required that leverage novel photo-detector technology, semiconductor process technology, circuit designs, architectures, and packaging and integration techniques.

The proposed avionic receiver must operate across a -40 °C to +95 °C temperature range, and maintain performance upon exposure to typical naval air platform vibration, humidity, temperature, altitude, thermal shock, mechanical shock, and temperature cycling environments [Refs 6-9]. The receiver must support a 10 dB link loss power budget when paired with a transmitter meeting similar environmental requirements, as well as applicable electro-optic performance restrictions. The receiver must be compatible with transmitters operating in the O band (1260-1360 nm range) and capable of receiving multi-wavelength signals transmitted over both single-mode fiber and 50 μm multimode fiber (Threshold performance). The receiver optical subassembly must be configurable to function at other wavelengths using high-speed photodetectors that operate at 850 nm, 980 nm, and 1,550 nm (Objective performance). The saturation level of the receiver must allow for operation while maintaining a bit error rate no greater than 1×10^{-12} over a link having 0 dB link loss and a transmitter having an extinction ratio of 4 dB operating at its highest allowed average power (Threshold average power of 10 dBm, and Objective average power of 15 dBm). The sensitivity of the receiver must allow for operation while maintaining a bit error rate no greater than 1×10^{-12} in a link with 10 dB link loss and a transmitter operating at its lowest allowed power of -5 dBm and an extinction ratio of 4 dB. The received signal must be retimed. Additionally, the full-rate signal may be converted (de-serialized) and output as multiple lower-rate signals. The electrical output of the receiver

must be differential current mode logic with a suitable pre-distortion mechanism to allow transmission of the electrical output across at least 4 in. (10 cm) of board-level interconnect. The electrical output of the receiver must provide receiver signal strength indication to the extent that SFF-8472 is appropriate for military avionics application [Ref 11].

The proposed receiver design must be capable of being demonstrated to perform reliably over the stated environmental, functional, and performance requirements with an Objective aggregate data rate of 200 Gbps. A Threshold performance level of 100 Gbps would represent an attractive option for near-term system deployment in concert with available digital fiber optic transmitter technology, while demonstrating a pathway to the 200 Gbps objective.

PHASE I: For a Direct to Phase II topic, the Government expects that the small business would have accomplished the following in a Phase I-type effort. Have developed a concept for a workable prototype or design to address, at a minimum, the basic requirements of the stated objective above. The below actions would be required in order to satisfy the requirements of Phase I:

Designed and analyzed an uncooled high-speed digital fiber optic receiver circuit and provided an approach for determining receiver parameters and testing. Designed a high-speed digital fiber optic receiver package prototype that is compatible with the receiver circuit design and coupling to optical fiber.

Determined and demonstrated the feasibility of the receiver design, the package prototype design, and a path to meeting Phase II goals based on analysis and modelling. The analysis and modeling should reference results obtained in previous efforts.

FEASIBILITY DOCUMENTATION: Offerors interested in participating in Direct to Phase II must include in their response to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic, but from non-SBIR funding sources) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the offeror and/or the principal investigator (PI). Read and follow all of the DON SBIR 21.2 Direct to Phase II Broad Agency Announcement (BAA) Instructions. Phase I proposals will NOT be accepted for this SBIR topic.

PHASE II: Optimize the receiver circuit and package designs. Build and test the receiver circuit and packaged receiver prototype to meet performance requirements. Characterize the receiver over temperature and perform highly accelerated life testing. If necessary, perform root cause analysis and remediate circuit and/or packaged receiver failures. Deliver packaged receiver prototypes for 50 Gbps and 100 Gbps digital fiber optic communication link application.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype. Verify and validate the receiver performance in an uncooled 100 Gbps fiber optic receiver that operates from -40 °C to +95 °C. Transition to applicable naval platforms.

Commercial sector telecommunication systems, fiber optic networks, and data centers could benefit from the development of high-speed receivers.

REFERENCES:

1. Binh, L. N. "Advanced digital optical communications (2nd ed.)." CRC Press, July 26, 2017. ISBN 1482226537. <https://doi.org/10.1201/b18128>.
2. Verbist, J., Verplaetse, M., Srivinasan, S. A., De Heyn, P., De Keulenaer, T., Pierco, R., Vaernewyck, R., Vyncke, A., Absil, P., Torfs, G., Yin, X., Roelkens, G., Van Campenhout, J. and Bauwelinck, J. "First real-time 100-Gb/s NRZ-OOK transmission over 2 km with a silicon electro-absorption modulator." 2017 Optical Fiber Communications Conference, Los Angeles, CA, United States, March 19-23, 2017. <https://ieeexplore.ieee.org/document/7937157>.
3. Ozkaya, I., Cevrero, A., Francese, P. A., Menolfi, C., Mort, T., Brändli, M., Kuchta, D. M., Kull, L., Baks, C. W., Proesel, J. E., Kossel, M., Luu, D., Lee, B. G., Doany, F. E., Meghelli, M., Leblebici, Y. and Toifl, T. "A 60-Gb/s 1.9-pJ/bit NRZ optical receiver with low-latency digital CDR in 14-nm CMOS FinFET." IEEE Journal of Solid-State Circuits, 53(4), February 7, 2018, pp. 1227-1237. <https://doi.org/10.1109/JSSC.2017.2778286>.
4. AS-3 Fiber Optics and Applied Photonics Committee (issuer). "AS5603A Digital fiber optic link loss budget methodology for aerospace platforms." SAE, January 23, 2018. <https://www.sae.org/standards/content/as5603a/>.
5. AS-3 Fiber Optics and Applied Photonics Committee (issuer). "AS5750A Loss budget specification for fiber optic links." SAE, January 23, 2018. <https://saemobilus.sae.org/content/as5750a>.
6. AS-3 Fiber Optics and Applied Photonics Committee (issuer). "ARP6318 Verification of discrete and packaged photonic device technology readiness." SAE, August 20, 2018. <https://saemobilus.sae.org/content/arp6318>.
7. "MIL-STD-810G: Environmental engineering considerations and laboratory tests." Department of Defense, October 31, 2008). http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810G_12306/.
8. "MIL-STD-883K: Test Method Standard Microcircuits." Department of Defense, 2008. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-883K_54326/.
9. "MIL-PRF-38534J: General Specification for Hybrid Microcircuits." Department of Defense, March 13, 2015 http://everyspec.com/MIL-PRF/MIL-PRF-030000-79999/MIL-PRF-38534J_52190/.
10. Kuchta, D. M., Rylyakov, A. V., Schow, C. L., Proesel, J. E., Baks, C. W., Westbergh, P., Gustavsson, J. S. and Larsson, A. "A 50 Gb/s NRZ modulated 850 nm VCSEL transmitter operating error free to 90°C." Journal of Lightwave Technology, 33(4), October 20, 2014. , pp. 802-810. <https://doi.org/10.1109/JLT.2014.2363848>.
11. "Specification for Management Interface for SFP+." <https://www.snia.org/technology-communities/sff/specifications>.

KEYWORDS: Digital Fiber Optic Receiver; Binary Non-return to zero signaling; 100 Gigabits per Second; 200 Gigabits per Second Packaging; Highly Accelerated Life Testing; data rate

TPOC-1: Obidon Bassinan
Phone: (301) 978-6155

TPOC-2: Andrew Brower
Phone: (908) 442-4839

N212-D05 TITLE: DIRECT TO PHASE II – Yield Increase for High-Performance Optical Interference Filters

RT&L FOCUS AREA(S): General Warfighting Requirements (GWR)

TECHNOLOGY AREA(S): Materials / Processes

OBJECTIVE: Develop processing and manufacturing techniques to significantly improve the yield of high-performance optical interference filter systems, thus reducing unit cost.

DESCRIPTION: Currently optical receiver systems use low to moderate performance interference filters to pass the desired wavelength light and block all unwanted wavelength light. As the receiver aperture size increases or the optical performance requirements (i.e., higher transmission, larger acceptance angle, lower bandpass width) increase, the cost of the optical filter increases dramatically. The cost increase is directly related to yield decrease due to limitations in coating uniformity when considering increased piece size or increased performance. For ultra-narrow high performance filters, reducing the non-uniformity to 0.1% and below is required to minimize wavelength shift and bandwidth broadening [Refs 2, 3].

In order to meet the emerging demands of large-aperture high performance optical filters while reducing costs, a system-level approach must be taken. Reducing non-uniformity to 0.01% over a large area is not feasible, but it is feasible to combine multiple high performance pieces into a single system while maintaining high fill factor. A high yield process will be required to reduce overall system cost.

This SBIR topic focuses on the development of a high yield, lower unit cost process for large area state-of-the-art (SOA) optical interference filter systems in the visible light spectrum. Filter performance goals for a filter line in the 460 to 490 nanometer range: 0.1 nm bandwidth, +/- 30 milli-radian acceptance angle, > 80% in-band system transmission, and > 4 orders of out of band blocking. Use MIL-STD-810 [Ref 1] for guidance on environmental storage and operating conditions.

PHASE I: For a Direct to Phase II topic, NAVAIR expects that the small business would have accomplished the following in a Phase I-type effort. It must have developed a concept for a workable prototype or design to address—at a minimum—the basic requirements of the stated objective above. The below actions would be required in order to successfully satisfy the requirements of Phase I:

- Developed a process to manufacture high-performance optical interference filter systems [Ref 4].
- Manufactured high-performance optical filter systems [Ref 4].
- Understood limitations of current processes, and identified methods and techniques to improve performance and yield of optical filter systems.

FEASIBILITY DOCUMENTATION: Proposers interested in participating in Direct to Phase II must include in their responses to this topic Phase I feasibility documentation that substantiates the scientific and technical merit and Phase I feasibility described in Phase I above has been met (i.e., the small business must have performed Phase I-type research and development related to the topic, but feasibility documentation MUST NOT be solely based on work performed under prior or ongoing federally funded SBIR/STTR work) and describe the potential commercialization applications. The documentation provided must validate that the proposer has completed development of technology as stated in Phase I above. Documentation should include all relevant information including, but not limited to: technical reports, test data, prototype designs/models, and performance goals/results. Work submitted within the feasibility documentation must have been substantially performed by the proposer and/or the principal investigator (PI). Read and follow all of the DON SBIR 212 Direct to Phase II BAA Instructions. Phase I Proposals will NOT be accepted for this BAA.

PHASE II: Based upon the work described in the Feasibility Documentation, develop and implement a process to consistently provide high-yield, high-performance filter systems. Demonstrate process success by providing a high-performance 100 mm diameter filter system prototype with a center wavelength in the 460 to 490 nm range, 0.1 nm bandpass, +/-30 mil acceptance angle, average in-band transmission of greater than 80%, and greater than 4 orders of out-of-band blocking. During the option period, if exercised, produce a large diameter (300 mm) prototype filter system with the same or better performance as the base demonstration unit, and demonstrate the feasibility of low-volume (10) unit costs of less than \$50,000.

PHASE III DUAL USE APPLICATIONS: Finalize the prototype, providing optical filter systems tailored to existing, or new, active and passive optical systems, as well as, provide integration assistance. Perform environmental testing consistent with various platform requirements and provide test results.

High-performance, low-cost optical filter systems can directly improve the performance of existing commercial LIDAR systems. Subcomponents of the filter system can be applied to short range lidar systems being considered for the autonomous automobile market, where unit cost at minimum performance is key.

REFERENCES:

1. "MIL-STD-810H, Department of Defense test method standard: Environmental engineering considerations and laboratory tests." Department of Defense, US Army Test and Evaluation Command, January 31, 2019. http://everyspec.com/MIL-STD/MIL-STD-0800-0899/MIL-STD-810H_55998/.
2. Macleod, H. A. "Chapter 11: Other topics: from rugate filters to photonic crystals." Thin-film optical filters (4th ed.), CRC Press, 2001. <https://www.amazon.com/Thin-Film-Optical-Filters-Optics-Optoelectronics/dp/1420073028>.
3. Rahmlow, T., Upton, T., Fredell, M., Finnell, T., Washkevich, S., Winchester, K., Hoppock, T. and Johnson, R. "Ultra-narrow bandpass coatings for deep space optical communications (DSOC) [Figure 9]. Omega Optical, Inc., September 13, 2017, p. 6. https://www.nasa.gov/sites/default/files/atoms/files/12_omega_optical_ultra_narrow_bandpass_coating_for_dsoc.pdf.
4. Johansen, A., Czajkowski, A., Scobey, M., Egerton, P. and Fortenberry, R. "Thin-film interference filters for LIDAR." Alluxa, April 9, 2017. <https://www.alluxa.com/learning-center/white-papers/thin-film-interference-filters-for-lidar/>.

KEYWORDS: Optical filter; high yield; narrowband; interference filter; thin-film; lidar

TPOC-1: Brian Concannon
Phone: (301) 342-2034

TPOC-2: Benjamin Decker
Phone: (301) 757-5396